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A Study of the Parasites of the Digestive Tract of Thirty-five Dogs.

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INTRODUCTION.

THE purpose of this paper is to give a survey of the incidence of parasitism in the digestive tract of a random selection of thirty-five dogs from this locality. It is of considerable importance in the field of parasitology to have as complete a record as possible of the parasites of all animals in a given locality. All of these dogs had been used previously for experimentation, but in no case had the digestive tract been disturbed. Arrangements were made so that it was possible to make examination of the tract immediately after the death of the animal.

It is surprising how many parasites are harbored by the dog. There are clinical records of cases where children have actually contracted helminthiasis, as the result of playing with an infested pet dog. The larval stage of a very common dog tapeworm, *Dipylidium caninum,* develops within the flea or louse which is so thoroughly "at home" on the dog. The accidental ingestion of such an infected flea or louse by a dog or man results in the development of the adult tapeworm in the individual ingesting the flea or louse. This particular tapeworm has been reported (Hall '15, 3) from an astonishingly large number of persons in the United States. The majority of such, and similar infections, have been in children.

The writer is greatly indebted to the Department of Physiology of the University of Kansas for the supply of material needed. All dogs were obtained through them.

Miss Mary E. Larson, assistant professor of zoölogy of the University of Kansas, was of great assistance in making this study. Her suggestions were of great value, and are greatly appreciated.

LITERATURE.

To the literature on this subject of parasites of the digestive tract of the dog Maurice C. Hall, of the Zoölogical Division, of the Bureau of Animal Industry of the United States Department of Agriculture, at Washington, D. C., has been the foremost contributor. Dr. B. M. Underhill, in his book entitled "Parasites and Parasitosis of Domestic Animals." sets forth in good form a valuable classification and brief discussions of the various parasites. Many other books and bulletins contain material on this subject, though they are not specially devoted to this field of parasitology.

METHOD OF PROCEDURE.

After the dogs had been killed by excessive etherization the digestive tracts were removed and immediately dropped into normal saline solution. The material was thus kept in excellent condition until it was possible for the examination to be made. Generally examination was made within the next hour or so. In order to examine the tract carefully it was taken from the normal saline and placed on a dissecting tray. Then, beginning at the posterior end (the lower portion of the large intestine) the tract was slit lengthwise. After laying the digestive canal open, the intestinal contents were removed and examined. The walls of the tract were scraped with a scalpel. All macroscopic animal life was removed by the use of forceps and placed in normal saline for subsequent killing and fixing with corrosive sublimate. After the parasites had been fixed they were placed in seventy per cent alcohol with iodine (the iodine was used to remove the excess of the sublimate) for twenty-four hours. The forms were then preserved in seventy per cent alcohol for further examination and identification. It was often possible to make further observations as to the condition of the dogs internally and externally.

DISCUSSION.

The macroscopic parasites found during the examination of the digestive tract of thirty-five dogs were tapeworms, hookworms, eelworms and whipworms. Tapeworms and hookworms were very frequent, while the eelworms and whipworms were not so often found. Following is a table showing the number and per cent of the total number of dogs infected by each of the different types of parasites:

Common name of parasite.	Number of dogs infected.	Per cent of dogs infected.
Tapeworms	29	83
Hookworms	29	83
Eelworms	5	14
Whipworms	4	11

It is evident that tapeworms and hookworms were both present in the greater portion of the dogs, but hookworms were not always present if the dog had tapeworms, or tapeworms always present if the dog had hookworms. The following table shows how frequently some of the different types were found in the same host:

Parasites found in the same host.	Number of dogs infected.	Per cent of dogs infected.
Tapeworms and hookworms	18	51.43
Tapeworms, hookworms and eelworms	5	14.29
Tapeworms, hookworms and whipworms,	3	8.57
Hookworms and whipworms	1	2.86
Hookworms (only)	2	5.71
Tapeworms (only)	3	8.57
No parasites	3	8.57
Total	35	100.00

As to the identification of these various forms little difficulty was encountered except in that of the tapeworms. In determining the genus and species of each form B. M. Underhill's book of 1920, "Parasites and Parasitosis of the Domestic Animals," was found to be exceedingly helpful.

The hookworm, which occurred so frequently, was of the species *Ankylostoma canina* (syn. *Dochmius trigonocephalus; Uncinaria trigonocephalus; Uncinaria canina*), (Underhill '20, 8), and belongs to the family Strongylidæ of class Nematoda. The number of individual hookworms found in one dog ranged from four to hundreds, or more than could readily be picked out and counted. The fact that hookworms are so small made it difficult for one to be sure that all present were found. Generally, each worm was securely fastened to the intestinal wall in the midst of a bloody and inflamed area, which was the result of its activity. As shown in the table above, hookworm infections were usually accompanied by tapeworm, eelworm, or whipworm infection. In every case there were practically twice as many female as male worms. *Ankylostoma canina* is the only kind of hookworm that occurs frequently in the dog of this country. Another species, *Uncinaria stenocephali*, has been reported, but the report has not been confirmed.

Ankylostoma canina produces an affection (Underhill '20, 8) in dogs which is analogous to ankylostomiasis or hookworm disease

of man, caused by *Ankylostoma duodenale*. Underhill states that the depression and indifference which result from such infection cause the lack of zest occasionally seen in hunting dogs. The disease usually attacks hunting packs in kennels, where reinfection is easy and the result is that the dogs become anemic, and soon almost worthless, unless treatment is instituted.

It is easy to see how hookworm infection may become common in kennels, but it is truly surprising that it is so frequent among the ordinary city dogs and house pets. Even in the latter cases the infection may become quite severe as can readily be observed by the characteristic harshness and loss of luster of their coats. It is fortunate indeed that this species of dog hookworm apparently never infects man.

The one species of eelworm, or ascarid, common in the dog is *Belascaris marginata,* of the family Ascaridæ of class Nematoda. It is most frequently found in young dogs of three or four months, and it is thought probable that about thirty per cent (Underhill '20, 8) of all puppies harbor the worm in the small intestines. But in our dogs, all of which were adults, *Belascaris marginata* was found in only five of the thirty-five, or fourteen per cent of the group. In one of these only one eelworm was found, but in the others the number ranged from four to nineteen.

The symptoms of eelworm infection are much like those caused by the presence of tapeworms. These symptoms are emaciation, irregular appetite and diarrhea or constipation. The infection of one parasite alone may be disastrous, while with two different kinds, such as eelworms and tapeworms, in a single host, fatal obstruction of the intestinal canal would be the expected results. The intestinal canal of one of the dogs examined was so filled with tapeworms that it seemed impossible that the tract had been able to carry on the process of elimination. Tangled in with this very great mass of tapeworms were a number of eelworms.

The whipworm found in dogs is *Trichuris depressiusculus* (syn. *Trichocephalus depressiusculus*), (Underhill '20, 8), of the family Trichinellidæ of class Nematoda. This peculiar worm was found to occupy the extreme tips of the ceca of four of the thirty-five, or eleven per cent of the dogs examined. They were not found in great numbers; the average per dog was eight worms. Each case of whipworm infection was accompanied by hookworm infection. There is no knowledge of these worms of the dog being of any pathogenic

importance, but the whipworm of man, *Trichuris trichura,* has been suggested as playing a part in the development of a diseased appendix (Chandler '20, 1).

The life cycle, the abundance, and the appearance of the tapeworms of class Cestoda make them of greater interest than the above-considered forms. They were found in eighty-three per cent of the dogs examined, and in the majority of these cases they were quite abundant. The following table gives the names and the frequency of the different tapeworms found. Identification was made on external characters principally. Underhill's book was the main source of descriptions.

Name of tapeworm.	Number of dogs infected.	Range in numbers of worms per dog.
Dipylidium	23	2-50
Tænia pisiformis	11	1-46
Tænia hydatigena	3	1-16
Multiceps	8	2-17
Unclassed ones (very small)	5	2-200

It was impossible to determine the species of *Multiceps.* There are possibilities of two species of this genus being present (*Multiceps multiceps* and *Multiceps serialis*). However, the chances are that the majority are *Multiceps serialis.* Underhill '20, 8, says that dogs having access to butchers' offal are often infected with *Multiceps multiceps* and *Tænia hydatigena,* the cystic forms of which are harbored in organs of sheep; while hunting dogs and those which roam about are more frequently infected with *Multiceps serialis* and *Tænia pisiformis,* which have their larval stages in rabbits. With all the modern equipment used by the butchers and packing houses to-day the accessibility of dogs to the wastes of the various animals is greatly reduced. Unless the cyst of *Multiceps multiceps* is obtained from the sheep of such places it is hard to imagine where they could get them, since very few sheep are raised in this territory. There are, however, many rabbits in this region of the country, so that all the dogs would easily have access to the cysts of *Multiceps serialis.* The scarcity of sheep in this territory probably also explains the fact that there were comparatively few dogs infected by *Tænia hydatigena.*

It is difficult to determine the species of the genus *Dipylidium* without making microscopic examination. *Dipylidium caninum* is quite generally accepted as the most common species of this genus. The fact that the cystic stage of *Dipylidium caninum,* the double-pored tapeworm, is in the flea or louse of the dog may explain the very great frequency of the presence of this genus of tapeworms.

Dipylidium was found in twenty-three, or seventy-nine per cent, of the twenty-nine dogs infected with tapeworms; or in sixty-five per cent of the thirty-five dogs examined. Some were only five or six inches long, and were quite slender, though mature. Others were fifteen inches long, and the mature and gravid proglottids were large. These worms were always found in considerable numbers whenever present at all.

Some of the specimens of *Tœnia pisiformis* had some very peculiar proglottids. Many of the worms were made up (wholly or partially) of proglottids, which were almost circular in shape and were only loosely attached to each other. The "chain" of such proglottids was extremely easy to break. Perhaps this condition was due to some degeneracy that was taking place in the tapeworm; but the writer has no definite explanation to offer.

The muscular activity of the individual gravid proglottids was often noticed with interest. In one instance, a number of them were placed in a water glass of normal saline solution and their peculiar activity was watched closely for four hours. After being unobserved for ten hours some of them were found to be still moving, but the movement was quite slow, and all died within the next two hours.

An interesting tapeworm is the three-sided one found in one dog (dog 26), which was very heavily infested with worms. This dog was host to ninety good-sized tapeworms besides the hundreds of the so-called small "unclassified ones." This somewhat unusual worm is eight inches long (preserved; during fixation it had no doubt contracted a great deal). Each proglottid, from the youngest to the most mature, is triangular in cross section. Dr. Maurice C. Hall says it "is one of the trihedral tapeworms, and this form of abnormality has been reported a number of times for a number of species." This one is of the species *Tœnia pisiformis.*

The tapeworms recorded as "unclassified ones" were small, not more than two and a half inches long, and quite slender. Some of the forms were mature, as was readily observed by the shape and the structure of the posterior proglottids. In one dog only two of them were found, while in another there were about two hundred. At first glance they resembled immature members of the species *Dipylidium caninum,* but the fact that these small forms were mature makes it very unlikely that this was the case. Hall and Wigdor ('18, 5), make reference to a species which may be the worm under consideration here. This tapeworm is called *Dipylidium sexcoronatum,* and is thought to be almost as common in Detroit, Mich., as *Dipylidium*

caninum. The description given by the above authors in this paper was not sufficient to determine whether or not the worms found here were of the same species. The frequency is sufficient to suggest the possibility of these worms being *D. sexcoronatum* found to be common in Detroit. They are undoubtedly of the genus *Dipylidium*, as they are double-pored, but the author is as yet unable to determine the species.

It was found that each parasite had a characteristic distribution in the digestive tract. The tapeworms were generally found in one great mass, and were usually all in the ileum. Only in one instance was there only a single tapeworm (*Tœnia pisiformis*), and it was near the pylorus (Sisson '17, 6). Only gravid proglottids, which had been shed, were found in the cecum or colon. The hookworms were usually scattered the full length of the small intestine, but if there were only a few, they were in the ileum. A few times some were found in the cecum, or the anterior region of the colon. Once a few were found in the stomach. The eelworms seemed to have no particular choice as to what region they occupied except that it be in the small intestine. When they were quite numerous the younger ones occurred anterior to the large ones. The whipworms were always found at the extreme tip of the cecum.

Dogs serve as intermediate hosts to parasites which cause a great economic loss in the raising of domestic animals. The "gid" parasite (Hall '10, 2 and '20, 4) which occurs in the brain or spinal cord of sheep, is the cystic stage of *Multiceps multiceps*, a tapeworm of the dog. Dogs should be kept free from tapeworms of any kind, and various means of treatment for removal may be used (Hall '20 4). If infection, of any type of parasites, is realized it would be advisable to administer treatment. The parasitism of dogs is a decidedly serious problem worthy of thoughtful consideration. We are all so familiar with the habits of the dog that the possibilities of it being a carrier of disease cannot be overlooked.

CONCLUSIONS.

1. Most of the dogs of this territory are infested with a number of different kinds of parasitic worms of the digestive tract.

2. The parasites found in the digestive tract of the thirty-five dogs examined were tapeworms, hookworms, eelworms, and whipworms.

3. Eighty-three per cent of the dogs examined were infected with tapeworms.

4. Different species of the cestode genera *Dipylidium, Tænia* and *Multiceps* were found in these dogs.

5. Eighty-three per cent of the dogs examined had hookworm infection. All hookworms were of the species *Ankylostoma canina.*

6. Fifty-one per cent of the dogs had both tapeworm and hookworm infection; but all dogs having tapeworm infection did not have hookworm or other parasitic infection.

7. Five per cent of this group of dogs were infected with eelworms of the species *Belascaris marginata.*

8. Four per cent of the dogs were infected with whipworms of the species *Trichuris depressiusculus.*

9. Eight and one-half per cent of the thirty-five dogs harbored no parasites in the digestive tract.

10. Few sheep are raised in this territory; therefore, few tapeworms of the species *Multiceps multiceps* and *Tænia hydatigena* were found, because they must have the sheep to harbor their cystic stages.

11. The parasitism of dogs is a problem worthy of consideration.

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